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ABSTRACT

The recent explosions of computer use and accessibility in both academic and work settings have made computer literacy almost mandatory, yet there are many individuals who are unfamiliar with computers. Previous research has partially attributed computer attitudes to past mathematics experience and gender of the user. This study empirically investigated the relationship between computer familiarity and cognitive ability in an attempt to identify cognitive ability as a variable which may account for differences in computer familiarity and usage. Subjects (N=62), ranging in age from 19 to 40 years of age, completed two cognitive ability tests and reported their familiarity with computers. Results indicated that high scorers on the cognitive ability tests were significantly more familiar with computers. Contrary to previous research, there were no gender differences in computer familiarity (and cognitive ability). The findings have implications for educational and organizational practices regarding teaching lower cognitive ability persons to use computers. Such programs should include confidence builders, reinforcers, and praise. The programs should move away from independent self-guided to continued instructor guidance programs. (Author/ABL)

Empirical Relationships Between Cognitive Ability and Computer Familiarity

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Running head: COMPUTER FAMILIARITY

Abstract

The recent explosion of computer use and accessibility in both academic and work settings has made computer literacy almost mandatory yet, there are many individuals who are unfamiliar with computers. Previous research has partially attributed computer attitudes to past math experience and gender of the user. The present study empirically investigated the relationship between computer familiarity and cognitive ability in an attempt to identify cognitive ability as a variable which may account for differences in computer familiarity and usage. Subjects completed two cognitive ability tests and reported their familiarity with computers. Results indicated that high scorers on the cognitive ability tests were significantly more familiar with computers. Contrary to previous research, there were no gender differences in computer familiarity (and cognitive ability). Plausible explanations for the results and its implications are discussed.

Empirical Relationships Between Cognitive Ability and Computer Familiarity

Over the past several years, there has been a dramatic increase in the use and importance of computers at work, in schools, and even at home (Campbell, 1984; Linn & Lepper, 1987; Merchant & Sullivan, 1983; National Commission for Employment Policy (NCEP), 1986). The impact of this, especially in education, has been enormous. Computers are being widely used as the subject of instruction as well as a tool for learning. Between 1981 and June 1984, the number of microcomputers in public schools increased from 30,000 to more than 630,000, and the number may rise to 3 million by 1992 (NCEP, 1986). In fact, it seems to be getting to the point where there is no avoiding computers (Merchant & Sullivan, 1983).

On the other hand, there are individual differences in computer usage and familiarity and one suggested reason for these differences is computer intimidation and phobia (Merchant & Sullivan, 1983). Dambrot, Watkins-Malek, Silling, Marshall and Garver (1985) cite a number of reasons offered to explain the widespread negative affect towards computers. These include: 1) functional problems with computer systems, 2) inadequate training in understanding and using computers, and 3) general resistance to change and new technology. There is also empirical evidence to suggest why people differ in their levels of computer familiarity. Dambrot et al. (1985) investigated the correlates of gender differences in attitudes toward, and involvement with, computers and found that gender and computer attitude consistently discriminated between groups differing in computer involvement. Computer attitude was also related to math experience and computer anxiety. Merchant and Sullivan (1983) also cite the results of a study which indicated that students with lower GPA and math scores generally suffer more from computer phobia. Female students exhibited a greater fear of computers than males. Additionally, Rosen, Sears, and Weil (1987) found that women had more negative attitudes regarding computers than men. They also note that older students are more computer anxious than younger students, although they do not display more negative attitudes, cognitions, or feelings regarding computer use. Finally, Watson and Alam (1986) found that one of the main predictors of computer course grades was feelings of challenge, leading them to ask whether "students' levels of intelligence and/or previously acquired computer skills could be the underlying aspect that enabled them to view [these] computer projects as an adventure" (p. 155).

The present study extends this literature by empirically investigating the relationship between computer familiarity (usage) and cognitive ability in an attempt to identify cognitive ability as a variable that may account for differences in people's familiarity with computers. Cognitive ability represents a basic determinant of learning and task performance. Numerous studies have investigated the role of cognitive ability in predicting individual differences in learning and task performance (e.g. Ackerman, 1987:, Klausmeier & Loughlin, 1961). Findings from this large amount of research show a substantial positive relationship between cognitive ability and task performance. Furthermore, cognitive ability helps individuals adapt to new situations, prioritize rules and regulations, and deal with unexpected problems (Hunter, 1986). Kagan and Pietron (1987) have noted that the analogy between computer learning and problem solving is commonly cited by many computer theoreticians. If initial computer interactions can be characterized as problem solving exercises, then it is logical to hypothesize that higher cognitive ability individuals are likely to feel more comfortable during these initial interactions and view computer usage as a problem solving challenge as opposed to an anxiety producing experience which will inevitably lead to failure. For instance Klausmeier and Ripple (1971) report that lower cognitive ability persons are less persistent at problem solving tasks and that repeated failures at these tasks result in giving up or showing other forms of unproductive behavior.

The notion of computer-avoidance also appeals in the work of Rosen et al. (1987). They reported that computer-anxious subjects showed less aptitude, literacy, and interest in computers. An integration of the reviewed literature thus tends to suggest that high cognitive ability persons are less likely to be computer-anxious and consequently, avoid computers. It is thus possible that some of the variance in computer familiarity may be explained by cognitive ability through a process of self-selection. That is, high cognitive ability persons may be more confident about, and less intimidated by computers (Watson & Alam, 1986), resulting in more usage and familiarity.

The second objective of this study was to attempt to replicate gender differences reported in other research (Rosen et al., 1987; Dambrot et al., 1985; Kiesler, Sproull, & Eccles, 1983; Merchant & Sullivan, 1983). Finally, from an aptitude-treatment interaction (ATI) perspective (Cronbach, 1967; Cronbach & Snow, 1977), the delineation of such relationships may be of potential use in the development of computer introduction courses in both academic and work environments.

Method

Sample

Participants were 62 full and part-time students. Forty-two percent were female. Two percent were in or had completed high school, 28% were in or had completed college, and 70% had completed or were currently in graduate school. Seventeen percent held regular full-time jobs. The oldest subject was 40 years old and the youngest 19, giving a mean age of 26.28 (_SD_=4.31).

Materials

Two measures were used to assess cognitive ability and a self report measure was used to assess computer familiarity. The measures were:

1. Advanced Progressive Matrices Set II (APM) (Raven, Court, & Raven, 1977). This was regarded as a test of general cognitive ability. It consisted of 36 matrix or design problems arranged in ascending order of difficulty. There was no time limit. The score was the total number of problems solved correctly.
2. Wesman Personnel Classification Test - Verbal Section (PCT-V) (Wesman, 1965). The verbal score was based on a 40-item, verbal analogies test. There was an 18-minute time limit. The score was the total number correct.
3. Self-Report Measure of Computer Familiarity. Subjects rated their familiarity with computers (and computer keyboards) on a three point rating scale ranging from 0 (Not Familiar) to 2 (Very Familiar) with mid-range point of 1 (Somewhat Familiar).

Procedure

The collection of data was divided into two sessions. In the first, subjects took the PCT and then the APM. When subjects returned for a second session to complete a computer simulated task as part of another study, they completed the familiarity scale. Intervals between the first and second sessions were varied across subjects since these sessions were scheduled at the subjects' convenience. However, none of the subjects performed both sessions on the same day.

Results

Means, standard deviations and intercorrelations for each of the measures are reported in Table 1. Inspection of Table 1 reveals that both cognitive ability measures are significantly positively correlated with computer familiarity. It is interesting to note that the relationship between the Raven (general cognitive ability) and computer familiarity is greater than that between the Wesman (verbal ability) and computer familiarity though this difference was not significant ($p>.05$). Gender was not significantly correlated with either measure of cognitive ability or with the familiarity measure.

Insert Table 1 about here

To further test these relationships, median-split *t* tests were computed. Results of these analyses confirmed the correlations indicating that high and low scorers on the Raven and Wesman differed significantly on their reported familiarity with computers, ($t(60) = -1.95$, $p<.05$; $t(52) = -2.02$, $p<.05$ respectively); high cognitive ability subjects were more familiar with computers than lower cognitive ability subjects.

To determine whether educational level might explain the relationship between computer familiarity and cognitive ability, a series of partial correlations were conducted. After controlling for education, the correlations between computer familiarity and the Raven and Wesman dropped to .37 ($p<.001$) and .24 ($p<.05$) respectively. However, in both instances, the differences between partialled and nonpartialled correlations were not significant ($p>.05$).

Discussion

The results strongly indicate that there is a positive relationship between performance on cognitive ability measures and one's familiarity (in terms of usage) with computers. Indeed, this difference though not significant, is higher for general cognitive compared to verbal ability. Generally, higher cognitive ability subjects reported more familiarity with computers. A plausible explanation for this finding, which is consistent with Merchant and Sullivan's (1983) research, is that those with lower cognitive ability scores are less able to adapt to, and deal with the problems and uncertainties often associated with computer interactions (Hunter, 1986; Arvey, 1986). That is, cognitively low ability persons report less familiarity with computers because they may self-select themselves away from computer interactions due to their (initially) problematic and possibly aversive nature.

Contrary to the results of other studies (Rosen et al., 1987; Dambrot et al., 1985; Merchant & Sullivan, 1983), no gender differences were obtained in computer familiarity (or cognitive ability). These findings tend to suggest that cognitive ability may be a more parsimonious variable than gender in explaining differences in computer familiarity. While the study sample may have been select (a... participants were engaged in some academic endeavor), and slightly homogeneous (70% were graduate students), this characteristic in fact highlights the robustness of the findings since sample homogeneity, with its associated range restriction, would make the results more conservative.

The findings have important implications for educational and organizational practices regarding teaching lower cognitive ability persons to use computers. First, such a program may incorporate confidence builders, reinforcers and praise (Anderson, Crowell, Doman, & Howard, 1988) to help overcome the uncertainties often associated with initial computer interactions and enhance computer use. Secondly, moving away from independent self-guided to continued instructor guidance programs may help reduce possible self-selection away from computer interactions. This recommendation should be extremely beneficial to the low cognitive ability scorer. Hunter (1986) has reported that cognitive ability determines how quickly a person learns and that "cognitive ability predicts the ability to react in innovative ways to situations where knowledge does not specify exactly what to do" (p. 342). Initial computer interactions are novel situations in which the individual must learn a wide range of new information. Without at least minimal on-hand guidance, those low in cognitive ability may become frustrated and intimidated by the computer, consequently avoiding any further interaction before having acquired any computer skills.

The present study was correlational and thus suffers from some of the shortcomings of such designs. Another shortcoming of this study is that it was based on a sample of college students (full and part-time). Therefore, one should be cautious not to overgeneralize these findings. A logical follow-up would be to assess the external validity of these findings on other samples.

Future research could also investigate the relationships between cognitive ability, computer aptitude and attitude, and computer familiarity, phobia and intimidation. Identifying the amount of variance explained by each independent variable and using path analysis to assess the links between the various variables in a predictive model would be an interesting follow up. For instance, we know from the work of Dambrot et al. (1985) that lower computer aptitude scores are related to negative computer attitudes. Does lower cognitive ability result in frustration, which in turn results in negative computer attitudes, or are the two variables independent? Path analysis would allow us to answer this question. A better understanding of these relationships would be enlightening in the development of more effective teaching and instructional strategies.

References

Ackerman, P. L. (1987). Individual differences in skill learning: An integration of psychometric and information processing perspectives. Psychological Bulletin, 102, 3-27.

Anderson, D. C., Crowell, C. R., Doman, M., & Howard, G. (1988). Performance posting, goal setting, and activity-contingent praise as applied to a university hockey team. Journal of Applied Psychology, 73, 87-95.

Arvey, R. A. (1986). General ability in employment: A discussion. Journal of Vocational Behavior, 29, 415-420.

Campbell, L. P. (1984). On the horizon: A computer in every classroom. Education, 104, 332-334.

Cronbach, L. J. (1967). How can instruction be adapted to individual differences? In R. M. Gagne (Ed.), Learning and individual differences. Columbus, OH: Charles Merrill.

Cronbach, L. J., & Snow, R. E. (1977). Aptitude and instructional methods. New York, NY: Irvington.

Dambrot, F. H., Watkins-Malek, M. A., Silling, M. S., Marshall, R. S., & Garver, J. A. (1985). Correlates of sex differences in attitudes toward involvement with computers. Journal of Vocational Behavior, 27, 71-86.

Hunter, J. E. (1986). Cognitive ability, cognitive aptitude, job knowledge, and job performance. Journal of Vocational Behavior, 29, 340-362.

Kagan, D., & Pietron, L. R. (1987). Cognitive level and achievement in computer literacy. The Journal of Psychology, 121, 317-327.

Kiesler, S., Sproull, F., & Eccles, J. S. (1983 March). Second class citizen? Psychology Today, 40-43, 46-48.

Klausmeier, H. J., & Ripple, R. E. (1971). Learning and human abilities. New York: Harper & Row.

Linn, S., & Lepper, M. R. (1987). Correlates of children's usage cf videogames and computers. Journal of Applied Social Psychology, 17, 72-93.

Merchant, R., & Sullivan, C. (1983). Microcomputers for everyone. Community College Review, 10, 8-11.

National Commission for Employment Policy (1986). Computers in the workplace: Selected issues. Rep rt No. 19.

Raven, J. C., Court, J. H., & Raven, J. (1977). Manual for Raven's Progressive Matrices and Vocabulary Scales. London: H. K. Lewis & Co. Ltd.

Rosen, L. D., & Sears, D. C., & Weil, M. M. (1987). Computerphobia. Behavior Research Methods, Instruments, and Computers, 19, 167-179.

Watson, W., & Alam, B. (1986). Computer terminal user motivation analysis: An application to achievement. Education and Psychological Research, 6, 145-156.

Wesman, A. G. (1965). Manual for Wesman Personnel Classification Test. New York, NY: The Psychological Corporation.

Table 1

Means, Standard Deviations and Correlations for all Measures

Measures	M	SD	2	3	4	5
1. Raven	25.21	5.67	.57***	.40***	.19	-.15
2. Wesman	27.32	6.37		.28**	.24*	-.04
3. Computer Familiarity	1.65	.57			.23*	.13
4. Educational Level[1]	2.68	.50				-.21*
5. Gender[2]						

Note. N = 62. * p<.05, ** p<.01, *** p<.001 (one tailed).

[1]High School=1; College=2; Graduate School=3.

[2]Gender correlations were computed using the point biserial (male=1, female=2).